

PORT DOCUMENTATION PAGE				DTIC FILE COPY	
1a. <b>AD-A189 355</b>		1b. RESTRICTIVE MARKINGS		3. DISTRIBUTION/AVAILABILITY OF REPORT	
2a. <b>AD-A189 355</b>		2b. <b>AD-A189 355</b>		Approved for public release; distribution unlimited.	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		5. MONITORING ORGANIZATION REPORT NUMBER(S)			
6a. NAME OF PERFORMING ORGANIZATION Center for Mathematical System Theory-University of Florida		6b. OFFICE SYMBOL (if applicable)		7a. NAME OF MONITORING ORGANIZATION U. S. Army Research Office	
6c. ADDRESS (City, State, and ZIP Code) 226 Larsen Hall Gainesville, FL 32611		7b. ADDRESS (City, State, and ZIP Code) P. O. Box 12211 Research Triangle Park, NC 27709-2211			
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U. S. Army Research Office		8b. OFFICE SYMBOL (if applicable)		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER DAAG29-85-K-0099	
8c. ADDRESS (City, State, and ZIP Code) P. O. Box 12211 Research Triangle Park, NC 27709-2211		10. SOURCE OF FUNDING NUMBERS			
		PROGRAM ELEMENT NO.		PROJECT NO.	TASK NO.
				WORK UNIT ACCESSION NO.	
11. TITLE (Include Security Classification) RESEARCH IN APPLIED MATHEMATICS RELATED TO IDENTIFICATION OF NOISY SYSTEMS (Unclassified)					
12. PERSONAL AUTHOR(S) Kalman, Rudolf Emil					
13a. TYPE OF REPORT Final Report		13b. TIME COVERED FROM 04/01/85 TO 07/30/87		14. DATE OF REPORT (Year, Month, Day) 1988 January 12	
15. PAGE COUNT 5					
16. SUPPLEMENTARY NOTATION The view, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.					
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)			
FIELD	GROUP	SUB-GROUP			
		Applied Mathematics; Noisy Systems; Noisy Analysis; Static Systems			
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
The research program for noisy analysis and noisy realization theory is only about half-way complete. An extensive amount of data analysis by computer was performed during the past two years, supplementing spot-checks in 1981-1984 on real data. These previous data analyses were important in showing that new research is needed. The empirical analysis of real data is related to the present build-up of the Center's own computer facilities and serves as a check on the programs being developed. The results of the theoretical and computer investigations on the identification of static systems (linear relations) will appear soon in the research monograph KALMAN [1988] that has been in preparation for several years. The objective of the monograph KALMAN [1988] is not only to explain the facts of life but also to enable the reader to duplicate the quite sophisticated data analysis procedures which we have developed. In short, the objective of the monograph is not polemical but tutorial.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS				21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL				22b. TELEPHONE (Include Area Code)	
				22c. OFFICE SYMBOL	

Research in Applied Mathematics  
Related to Identification of Noisy Systems

Final Report

January 1988

R. E. Kalman  
Principal Investigator

April 1, 1985 through September 30, 1987

U. S. Army Research Office  
Grant Number DAAG29-85-K-0099

Center for Mathematical System Theory  
University of Florida

Approved for public release;  
distribution unlimited.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

THE VIEW, OPINIONS, AND/OR FINDINGS CONTAINED IN THIS REPORT ARE THOSE OF THE  
AUTHOR(S) AND SHOULD NOT BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY  
POSITION, POLICY, OR DECISION, UNLESS SO DESIGNATED BY OTHER DOCUMENTATION.

The grant period reported here (1985-1987) was, in many respects, a transitional one. Many of the publications listed below refer to work continued (or completed) from earlier grant periods. Two of the authors---BIRGET and EMRE---were postdoctoral fellows at the CENTER FOR MATHEMATICAL SYSTEM THEORY; their publications reflect continuing research at other universities, under support other than ARO-Durham.

The publications of BIRGET and EMRE belong, broadly speaking, to algebraic system theory. This direction of research is still active at the Center, but the main emphasis has shifted since 1985 to the analysis and theory of systems observed via noisy data.

Since the research program for noisy analysis and noisy realization theory is only about half-way complete, the number of publications reporting results of this phase of the grant are, at the moment, rather limited. (There are a number of internal unpublished lecture notes which are not available for general distribution.) See, however, two papers by the Principal Investigator, KALMAN [1985, 1987], which present the organizing ideas of the current investigation.

An extensive amount of data analysis by computer was performed during the past two years, supplementing spot-checks in 1981-1984 on real data (for example, the published data on the so-called Tintner meat-market problem). These previous data analyses were important in

showing that new research is needed. The empirical analysis of real data is related to the present build-up of the Center's own computer facilities and serves as a check on the programs being developed.

The results of the theoretical and computer investigations on the identification of static systems (linear relations) will appear soon in the research monograph KALMAN [1988] that has been in preparation for several years. There is a great deal of confusion in the literature about what the scientific issues of identification are. A coherent presentation of the results is almost impossible without a certain amount of tutorial material. The objective of the monograph KALMAN [1988] is not only to explain the facts of life but also to enable the reader to duplicate the quite sophisticated data analysis procedures which we have developed. In short, the objective of the monograph is not polemical but tutorial.

As soon as the Center computer facilities are fully operational and tested, we would be very interested in looking at real-data problems of Army Research Laboratories, not only to help them but to explore the potential breadth and applicability of the new methods.

References

R. E. KALMAN

- [1987] "The problem of prejudice in scientific modeling", (to appear).
- [1988] IDENTIFICATION, research monograph, Springer, (to appear).

## PUBLICATIONS SUPPORTED BY THE GRANT

J. C. BIRGET

- [1986] "Stability and j-depth of expansions", accepted by Bulletin of Australian Mathematical Society.
- [1986] "The synthesis theorem for finite regular semigroups, and its generalization", 115 pages, accepted by Journal of Pure and Applied Algebra.
- [1987] "Concatenation of inputs in a two-way automaton", 24 pages, submitted to Theoretical Computer Science.
- [1987] "Two-way automaton computations", 34 pages, submitted to RAIRO, Informatique Theorique.

E. EMRE and J. H. SEO

- [1987] "A realization theoretic solution of two analytic matrix equations with application to stabilization of infinite dimensional systems", November 1986, 20 pages, to appear in the Proceedings of the International Symposium of Mathematical Theory Networks and Systems, Arizona, 1987.
- [1987] "A realization theoretic solution of two analytic matrix equations with application to stabilization of infinite dimensional systems", 33 pages, submitted to IEEE Transactions on Automatic Control.

E. EMRE, H. TAI, and J. H. SEO

- [1987] "Transfer matrices, polynomial fractions and realization of continuous-time linear time-varying systems", 10 pages, to appear in Proceedings of the Allerton Conference, October 1987.
- [1987] "Transfer matrices, realization and control of continuous-time linear time-varying systems via polynomial fractional representations", 37 pages, submitted to IEEE Transactions on Automatic Control.

J. HAMMER

- [1987] "Assignment of dynamics for nonlinear recursive feedback systems", 41 pages, to appear in the Journal of Control.

PERSONNEL SUPPORTED UNDER THE GRANT

(a) Regular Personnel

Dr. R. E. Kalman, Principal Investigator

(b) Visitors

Short-term visitors for 1985/87

Dr. A. Lindenmayer, University of Utrecht, THE NETHERLANDS

Dr. Y. Rouchaleau, (now of Ecole Nationale Supérieure des Mines de Paris, FRANCE)

Dr. J. Waldvogel, University of South Florida, Tampa, FL

Long-term visitors for 1985/87 (one month or more)

Dr. J.-C. Birget, (now on faculty of University of Nebraska)

Dr. E. Emre, (now on faculty of Texas Technical University)